

CLAIMS

What is claimed is:

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1. A method for encapsulating a signaling connection control part (SCCP) message in an Internet protocol (IP) datagram using a transport adapter layer interface (TALI), the method comprising:
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- (a) receiving an SS7 message signal unit (MSU), the SS7 MSU including message transfer part (MTP) layers 1, 2, and 3 and an SCCP layer;
  - (b) discarding MTP layer 1 and 2 information from the SS7 MSU;
  - (c) placing the SCCP layer in a service portion of a TALI packet;
  - (d) adding a TALI header to the TALI packet; and
  - (e) adding transmission control protocol (TCP) and IP headers to the TALI packet.
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2. The method of claim 1 comprising placing MTP layer 3 information without modification into the service portion of the TALI packet.
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3. The method of claim 1 comprising extracting MTP layer 3 information from the SS7 MSU and placing the MTP layer 3 information in the SCCP layer.
4. The method of claim 3 wherein extracting MTP layer 3 information includes extracting an originating point code (OPC) value from the SS7 MSU and placing the MTP layer 3 information in the SCCP layer

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5. The method of claim 3 wherein extracting MTP layer 3 information includes extracting a destination point code (DPC) value from the SS7 MSU and placing the MTP layer 3 information in the SCCP layer includes placing the DPC value in a called party address field in the SCCP layer.

7. The method of claim 1 comprising setting a LENGTH field in the TALIP packet to a value indicative of the LENGTH of the service portion of the TALIP packet.

8. The method of claim 1 comprising setting an OPCODE field in the TALIP packet to a predetermined value for identifying the TALIP packet as an SCCP packet.

9. A method for encapsulating a message transfer part layer 3 (MTP3) packet in an Internet protocol (IP) datagram using a transport adapter layer interface (TALI), the method comprising:

- (a) receiving an MTP3 message signal unit (MSU), the MTP3 MSU including MTP layers 1, 2, and 3;
- (b) discarding MTP layers 1 and 2 from the MTP3 MSU;
- (c) placing MTP layer 3 information from the MTP3 MSU in a service portion of a TALI packet;
- (d) adding a TALI header to the TALI packet; and
- (e) adding transmission control protocol (TCP) and IP headers to the TALI packet.

10 10. The method of claim 9 wherein placing the MTP layer 3 information in the service portion includes placing a routing label and a service indicator octet (SIO) in the service portion of the TALI packet.

15 11. The method of claim 10 wherein placing the MTP layer 3 information in the service portion includes placing layer 3 information in addition to the routing label and the SIO in the service portion of the TALI packet.

20 12. The method of claim 11 wherein placing information in addition to the routing label and the SIO includes placing network management information in the service portion of the TALI packet.

25 13. The method of claim 12 wherein placing network management information in the service portion of the TALI packet includes placing changeover information in the service portion of the TALI packet.

14. The method of claim 12 wherein placing network management information in the service portion of the TALI packet includes placing changeback information in the service portion of the TALI packet.
15. The method of claim 12 wherein placing network management information in the service portion of the TALI packet includes placing flow control information in the service portion of the TALI packet.
16. The method of claim 11 wherein placing information in addition to the routing label and the SIO includes placing network testing information in the service portion of the TALI packet.
17. The method of claim 16 wherein placing network testing information in the service portion of a TALI packet includes placing signaling-route-set-test information in the service portion of the TALI packet.
18. The method of claim 9 comprising setting a SYNC field in the TALI packet to a predetermined value indicating the beginning of the TALI packet for stream-oriented communications.
19. The method of claim 9 comprising setting a LENGTH field in the TALI packet to a value indicative of the LENGTH of the service portion of the TALI packet.

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24. The method of claim 23 comprising in response to failing to receive the reply within the predetermined time period, attempting the re-establish communications over the first TCP connection.
25. The method of claim 23 wherein the predetermined time period is less than a TCP disconnection timeout value.
26. The method of claim 23 wherein transmitting a first message includes transmitting a TALI test message and listening for a reply includes listening for a TALI allow or prohibit message.
27. The method of claim 23 comprising, in response to receiving the reply, determining a round trip time (RTT) between the first and second signaling nodes.
28. The method of claim 27 wherein determining a round trip time includes:
- (a) reading a local timer value and inserting the local timer value in the first message;
  - (b) reading the local timer value when the reply is received;
  - (c) reading a timer value from the reply; and
  - (d) computing the RTT based on the difference between the timer value in the reply and the local timer value when the reply was received.

29. The method of claim 23 comprising inserting a local transport adapter layer interface version number in the first message.
30. A method for suspending and resuming SS7 message communications over a transmission control protocol (TCP) connection, the method comprising:
- (a) establishing a first TCP connection between a first signaling node and a second signaling node;
  - (b) sending and receiving TCP/IP-encapsulated SS7 messages over the first TCP connection; and
  - (c) receiving a first control message over the first TCP connection and, in response, stopping the sending of SS7 messages over the first TCP connection.
31. The method of claim 30 comprising, after receiving the first control message, resuming the sending of SS7 messages over the first TCP connection in response to receiving a second control message over the first TCP connection.
32. The method of claim 30 comprising, in response to receiving the first control message, switching SS7 communications between the first and second signaling nodes to a second TCP connection established between the first and second signaling nodes.

33. The method of claim 30 wherein receiving a first control message includes receiving the first control message signed using a predetermined encryption algorithm and verifying that the first control message originating from an authorized node using the first encryption algorithm.

34. The method of claim 30 wherein establishing a TCP connection between first and second signaling nodes includes establishing the first TCP connection between a signaling gateway and a media gateway controller.

35. The method of claim 30 wherein establishing a connection between first and second signaling nodes includes establishing a connection between a first SS7 signaling node and an IP node.

36. The method of claim 30 wherein establishing a connection between first and second signaling nodes includes establishing a connection between a first IP-capable SS7 signaling node and a second IP-capable SS7 node.

37. A method for processing transport adapter layer interface (TALI) messages received over a stream-oriented connection, the method comprising:

- (a) receiving a plurality of TALI messages over a stream-oriented connection;



- (b) identifying the beginning of each of the TALI messages using a first field in each of the TALI messages;
- (c) identifying the end of each of the TALI messages using a second field in each of the TALI messages; and
- 5 (d) extracting individual TALI message packets using the first and second fields.

10 38. The method of claim 37 comprising identifying the content of each of the TALI messages using a third field in each of the TALI messages.

39. The method of claim 37 wherein receiving a plurality of TALI messages over a stream-oriented connection includes receiving a plurality of TALI messages over a transmission control protocol (TCP) connection.

15 40. The method of claim 37 wherein identifying the beginning of each of the TALI messages includes identifying each of the TALI messages using a SYNC field in each of the TALI messages.

20 41. The method of claim 37 wherein identifying the end of each of the TALI messages using a second data field includes identifying the end of each of the TALI messages using a LENGTH field for specifying the length of a data portion of each of the TALI messages.

25 42. The method of claim 38 wherein identifying the content of each of the TALI messages using a third data field includes identifying the content of

each of the TALI messages using an OPCODE field for specifying the content of each of the TALI messages.

43. The method of claim 37 wherein a data portion of each of the TALI messages carries SS7 information.

44. A computer program product comprising computer-executable instructions embodied in a computer-readable medium for performing steps comprising:

- (a) receiving an SS7 message signal unit (MSU), the SS7 MSU including message transfer part (MTP) layers 1, 2, and 3 and an SCCP layer;
- (b) discarding MTP layer 1 and 2 information from the SS7 MSU;
- (c) placing the SCCP layer in a service portion of a TALI packet;
- (d) adding a TALI header to the TALI packet; and
- (e) adding transmission control protocol (TCP) and IP headers to the TALI packet.

45. The computer program product of claim 44 comprising placing MTP layer 3 information without modification into the service portion of the TALI packet.

46. The computer program product of claim 44 comprising extracting MTP layer 3 information from the SS7 MSU and placing the MTP layer 3 information in the SCCP layer.

47. The computer program product of claim 46 wherein extracting MTP layer 3 information includes extracting an originating point code (OPC) value from the SS7 MSU and placing the MTP layer 3 information in the SCCP layer includes placing the OPC value in a calling party address field in the SCCP layer.

48. The computer program product of claim 46 wherein extracting MTP layer 3 information includes extracting a destination point code (DPC) value from the SS7 MSU and placing the MTP layer 3 information in the SCCP layer includes placing the DPC value in a called party field address in the SCCP layer.

49. The computer program product of claim 44 comprising setting a SYNC field in the TALI packet to a predetermined value indicating the beginning of the TALI packet for stream-oriented communications.

50. The computer program product of claim 44 comprising setting a LENGTH field in the TALI packet to a value indicative of the LENGTH of the service portion of the TALI packet.

51. The computer program product of claim 44 comprising setting an OPCODE field in the TALI packet to a predetermined value for identifying the TALI packet as an SCCP packet.

52. A computer program product for comprising computer-executable instructions embodied in a computer-readable medium for performing steps comprising:
- (a) receiving an MTP3 message signal unit (MSU), the SS7 MSU including MTP layers 1, 2, and 3;
  - (b) discarding MTP layers 1 and 2 from the MTP3 MSU;
  - (c) placing MTP layer 3 information from the MTP3 MSU in a service portion of a TALI packet;
  - (d) adding a TALI header to the TALI packet; and
  - (e) adding transmission control protocol (TCP) and IP headers to the TALI packet.
53. The computer program product of claim 52 wherein placing the MTP layer 3 information in the service portion includes placing a routing label and a service indicator octet (SIO) in the service portion of the TALI packet.
54. The computer program product of claim 53 wherein placing the MTP layer 3 information in the service portion includes placing layer 3 information in addition to the routing label and the SIO in the service portion of the TALI packet.
55. The computer program product of claim 53 wherein placing information in addition to the routing label and the SIO, includes placing network management information in the service portion of the TALI packet.

56. The computer program product of claim 55 wherein placing network management information in the service portion of the TALI packet includes placing changeover information in the service portion of the TALI packet.
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57. The computer program product of claim 55 wherein placing network management information in the service portion of the TALI packet includes placing changeback information in the service portion of the TALI packet.
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58. The computer program product of claim 55 wherein placing network management information in the service portion of the TALI packet includes placing flow control information in the service portion of the TALI packet.
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59. The computer program product of claim 54 wherein placing information in addition to the routing label and the SIO includes placing network testing information in the service portion of the TALI packet.
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60. The computer program product of claim 59 wherein placing network testing information in the service portion of a TALI packet includes placing signaling-route-set-test information in the service portion of the TALI packet.

61. The computer program product of claim 52 comprising setting a SYNC field in the TALI packet to a predetermined value indicating the beginning of the TALI packet for stream-oriented communications.
- 5 62. The computer program product of claim 52 comprising setting a LENGTH field in the TALI packet to a value indicative of the LENGTH of the service portion of the TALI packet.
- 10 63. The computer program product of claim 52 comprising setting the OP CODE field to a predetermined value for identifying the TALI packet as an MTP3 packet.
64. The computer program product of claim 52 comprising adding an application layer sequence number to the TALI packet.
- 15 65. The computer program product of claim 64 comprising adding an application layer sequence number includes adding a service specific connection oriented protocol (SSCOP) trailer to the TALI packet.
- 20 66. A computer program product comprising computer-executable instructions embodied in a computer-readable medium for performing steps comprising:
- 25 (a) establishing a first transmission control protocol (TCP) connection for communicating SS7 messages between a first signaling node and a second signaling node;

- (b) transmitting a first message encapsulated in a TCP segment over the first TCP connection;
- (c) listening for a reply to the first message over the first TCP connection; and
- 5 (d) in response to failing to receive the reply within a predetermined time period, treating the first TCP connection as being disabled.

67. The computer program product of claim 66 comprising in response to failing to receive the reply within the predetermined time period, attempting the re-establish communications over the first TCP connection.

68. The computer program product of claim 66 wherein the predetermined time period is less than a TCP disconnection timeout value.

69. The computer program product of claim 66 wherein transmitting a first message includes transmitting a TALI test message and listening for a reply includes listening for a TALI allow or prohibit message.

70. The computer program product of claim 66 comprising, in response to receiving the reply, determining a round trip time (RTT) between the first and second signaling nodes.

71. The computer program product of claim 70 wherein determining a round trip time includes:

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73. A computer program product comprising computer-executable instructions embodied in a computer-readable medium for performing steps comprising:

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- 5 75. The computer program product of claim 73 comprising, in response to receiving the first control message, switching SS7 communications between the first and second signaling nodes to a second TCP connection established between the first and second signaling nodes.
- 10 76. The computer program product of claim 73 wherein receiving a first control message includes receiving the first control message signed using a predetermined encryption algorithm and verifying that the first control message originated from an authorized node using the first encryption algorithm.
- 15 77. The computer program product of claim 73 wherein establishing a TCP connection between first and second signaling nodes includes establishing the first TCP connection between a signaling gateway and a media gateway controller.
- 20 78. The computer program product of claim 73 wherein establishing a connection between first and second signaling nodes includes establishing a connection between a first SS7 signaling node and an IP node.

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(b) a transmission control protocol/Internet protocol (TCP/IP) process  
25 for receiving the TALI messages from the TALI process, adding

TCP and IP headers to the TALI messages, and forwarding the TALI messages to a receiving application over an IP network based on the TCP and IP headers.

- 5 88. The communications network element of claim 87 comprising a data communications module (DCM) including hardware for sending and receiving messages over the IP network, wherein the TALI process is implemented on the DCM.
- 10 89. The communications network element of claim 88 wherein the TCP/IP process is implemented on the DCM.
90. The communications network element of claim 87 wherein the TCP/IP process is adapted to receive a stream of TCP data from the IP network.
- 15 91. The communications network element of claim 90 wherein the TALI process is adapted to receive the stream of TCP data from the TCP/IP process and to identify individual TALI message boundaries in the stream.

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